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# DETERMINING FACTORS IN THE RELIABILITY OF THE IRRIGATION SYSTEM OF KOTO KANDIS, INDONESIA

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## ABSTRACT

The construction of irrigation infrastructure in Indonesia continues to increase to fulfill the need for food. However natural disasters, limits to operating and maintenance funding and other factors often result in less than optimal operation of these systems. If one part of the system is lack operational then the whole system will be affected. Continuity of supply is very dependent on the reliability of water supply, the irrigation structures and farmers using the irrigation water in an optimal manner. An irrigation system must be reliable over the whole course of its service, not only in the planning stages but also in subsequent phases so it must be managed as efficiently as possible. This study identified the factors determining the reliability of the irrigation system in the 2,665 ha irrigation area of Koto Kandis in Pesisir Selatan district, West Sumatera province. The factors that play a major role in this system were discovered to efficiency of technical operation and maintenance management (23.91%), the existence of effective supervision also sanctions and operation and maintenance management regulatory structures (22.17%). The consistency ratio for these results was 4.42%.

**KEYWORDS**: reliability of irrigation systems, water supply, irrigation, determining factors, operation and maintenance

## 1. INTRODUCTION

The demand for food increases with increasing population and requires continual effort to increase production. The result of rapid assessment that was carried out by the Ministry of Public Work in 2010 indicates that only 48% of the irrigation system of the country was in good working order. (Mudjiadi, 2012). The poor condition of one part of an irrigation system with negatively affect the efficiency and effectiveness of the whole system. (Directorate for Irrigation Management, 2014).

The maintenance of irrigation system is of primary importance to the development of agriculture but the system has fallen into disrepair for a number of reasons The most significant ones being lack of or deferment of maintenance due to lack of operational and maintenance (O & M) funding, deliberate human action and natural disasters (www.litbang.pu.go.id).

The problem of the reliability of the irrigation infrastructure in Indonesia has become a point of contention because on the one hand according to the mandate of Government regulation No. 20/2006, construction of both primary and secondary irrigation systems is the responsibility of the government level, provincial level or district/city level, on the other hand the responsibility for the operation and maintenance of the system lies with the institution management as the primary actor.

As a result the standard of maintenance of an irrigation is highly dependent on the role of each area's responsibility. This article offers an outline of the determining factors that influence the reliability of the irrigation system of Koto Kandis, 2,665 ha in Pesisir Selatan district with the intention of offering solutions for the problems of reliability of the system so the benefits of irrigation can be optimized and reliability improved.

## 2. METHODOLOGY

### Approach

According Pasandaran (1991) irrigation system reliability is its ability to maintain its functions for example; the rate of water supply, water

  

distribution, efficiency of irrigation to achieve agricultural goals such as increased rice yield. As production in an area increases so the performance of the irrigation system will also need to increase. The reliability of an irrigation system depends on its ability to function beyond the planning and construction phase and needs increasingly efficient operation and maintenance systems.

This article examines the management factors that determine reliability of an irrigation system from the point of view of supply of water. The different factors that were significant in each part of the management process were identified through the study of literature and then validated using interviews with respondents draw from a purposive sample. The resulting list of these determinant factors can be seen in Table 3.1 below:

Table 3.1 Factors determining the O & M reliability of irrigation system for Koto Kandis

| No | Adequacy of irrigation water supply (Focus : Primary and secondary irrigation system) | Notoatmojo (1991) | Schultz B. and Wrachien D.D (2002) |
|---|---|---|---|
| 1 | Number of personnel | v | |
| 2 | Quality of personnel involved in O & M | | v |
| 3 | Adequate budget from the associated organization | | v |
| 4 | Institutional strengthening | | |
| 5 | Good coordination between personnel | v | |
| 6 | Technical management efficiency | v | |
| 7 | Fiscal management efficiency | v | |
| 8 | Integration of management strategies for irrigation and drainage systems | | v |
| 9 | Management strategies appropriate to existing financial and socio – economic and environmental situation | | v |
| 10 | The existence of appropriate regulations related to the management of O & M | | v |
| 11 | Existence of supervision and sanctions | | v |

**Data collection**

Primary data obtained from observation and in-depth interviews in a focus group discussion with two of the five engineer responsible for Koto Kandis irrigation system. Selection of these respondents was intentional as they could provide the needed information. Both are experts in the topic with 5-10 year work experience so were sufficiently skilled and able to make consistent comparisons between the criteria and sub - criteria in the Analysis Hierarchy Process (AHP) questionnaire format to be regarded as valid respondents in the AHP. Secondary data was obtained from related documentation from the relevant agencies rather than direct measurements in the field.

**Identification and Validation of Relevant Data (Questionnaire)**

Identification and selection of the determining factors of infrastructure reliability was obtained from the literature. A questionnaire was constructed listing these factors and respondents were asked to judge the importance of each of these factors on the reliability of irrigation system in their area, on a scale from 1 to 9. Ratings of 1-3 were interpreted as less important factors, 4-6 as significant, while 7-9 were interpreted as very important. Hence the relevant determining factors for irrigation systems in the Koto Kandis irrigation system were determined.

**Field Observations**

Observations were conducted at several locations along irrigation system to compare questionnaire responses with reality. These surveys are also useful in the process of analysis and discussion of further research

# 3. DISCUSSION

**AHP implementation**

AHP is implemented in four steps (Saaty, 2008) :

1. Defining the problem and determine the objectives to be sought (level 1);
2. Determine the factors that influence the goal.

These factors are then structured into criteria and sub criteria (level 2 & 3);

3. Comparing the relative importance of each criteria/sub-criteria to form a weighted comparison matrix and ranking eigenvalues.

a. Comparison matrix A

In order to calculate the weighting of the different criteria, AHP makes a Pairwise Comparison Matrix A (matrix $n$x$m$ , where $n$ is the number of criteria were evaluated , and $m$ is the number of possible comparisons, where $m = n(\frac{(n-1)}{2})$. Each entry $a_{ij}$ represents the relative importance of criteria "$i$" against the criteria "$j$". If entry $a_{ij} > 1$ , then the criterion of "$i$" is more important than the criterion of "$j$". If entry $a_{ij} < 1$ , then the criterion of "$i$" is less important than the criterion of "$j$" , and if two of these criteria have the similar importance , then entry $a_{ij} = 1$.

The entries $a_{ij}$ and $a_{ji}$ in the matrix A are related as follows :

$a_{ij}$ x $a_{ij} = 1$ ……………………… (1)

It can been seen that $a_{ij}$ is 1 for all values of "$j$" and the relative importance of the two criteria is based on numeric scale 1 to 9. (Table 4.1, and 4.2).

Table 4.1 explains the meaning of the numerical values 1, 3, 5, 7 and 9 in the comparison matrix in terms of the relative importance assigned to the two criteria being compared. If responses do not easily fall into these categories then intermediate values of 2, 4, 6, and 8 were assigned.

Table 4.1 Interpretation of comparison scores between sub criteria (level 3)

| Score | Interpretation |
|---|---|
| 1 | The first sub criteria is equally important to the second. |
| 3 | The first sub criteria is slightly more important to the second. |
| 5 | The first sub criteria is significantly more important to the second. |
| 7 | The first sub criteria is far more important to the second. |
| 9 | The first sub criteria is extremely more important to the second. |
| 2, 4, 6, 8 | Values indicating intermediate rating of importance on the scale above |

Table 4.2 Interpretation of comparison scores between criteria/sub criteria

| Score | Interpretation | *i value* | *j value* |
|---|---|---|---|
| *If i is more important than j* | | | |
| 1 | Sub criteria *i* is equally important to sub criteria *j* | 1 | 1 |
| 3 | Sub criteria *i* is slightly more important to sub criteria *j* | 3 | 1/3 |
| 5 | Sub criteria *i* is significantly more important to sub criteria *j* | 5 | 1/5 |
| 7 | Sub criteria *i* is far more important to sub criteria *j* | 7 | 1/7 |
| 9 | Sub criteria is extremely more important to sub criteria *j* | 9 | 1/9 |
| *If j is more important than i* | | | |
| 1 | Sub criteria *j* is equally important to sub criteria *i* | 1 | 1 |
| 3 | Sub criteria *j* is slightly more important to sub criteria *i* | 1/3 | 3 |
| 5 | Sub criteria *j* is significantly more important to sub criteria *i* | 1/5 | 5 |
| 7 | Sub criteria *j* is far more important to sub criteria *i* | 1/7 | 7 |
| 9 | Sub criteria *j* is extremely more important to sub criteria *i* | 1/9 | 9 |

b. Weight of normalized principal Eigenvector of the comparison matrix *"$A_{norm}$"*

Normalization of the pairwise comparison matrix *"Anorm"* was conducted by dividing each value by the sum of the entries in each column, for instance entry, $\bar{a}_{ij}$ from matrix $A_{norm}$, is calculated as

$$\bar{a}ij = \frac{aij}{\sum_{l=1}^{n} aj1} \text{ …….………… (2)}$$

The weight of the principal eigenvector "w" is obtained by taking the average entry from each line of $A_{norm}$ as follows:

$$wj = \frac{\sum_{l=1}^{n} aj1}{n} \text{ ……….……… (3)}$$

where $n$ is the dimension of the column vector

From the above formula it can be observed that the weight of the eigenvectors for the criteria and sub criteria are obtained from the geometric mean of each row, elements from each row are multiplied together then the nth root calculated ($n$ being the number of elements in a row). Hence, the principal eigenvector is obtained from squaring the pairwise comparison matrix then adding the elements in each row together and dividing each element by the sum of the rows. (Saaty, 2008). To make this easier to understand, the pairwise comparison matrix formulation is approximated by four criteria (Table 4.3) and the procedure used described in the flow chart Figure 4.1

Table 4.3 Comparation Criteria ($A_{4x4}$)

| Criteria | $Cr_{j1}$ | $Cr_{j2}$ | $Cr_{j3}$ | $Cr_{j4}$ | |
|---|---|---|---|---|---|
| $Cr_{i1}$ | $Cr_{i1j1} = 1$ | $Cr_{i1j2}$ | $Cr_{i1j3}$ | $Cr_{i1j4}$ | |
| $Cr_{i2}$ | $Cr_{i2j1}$ | $Cr_{i2j2} = 1$ | $Cr_{i2j3}$ | $Cr_{i2j4}$ | |
| $Cr_{i3}$ | $Cr_{i3j1}$ | $Cr_{i3j2}$ | $Cr_{i3j3} = 1$ | $Cr_{i3j4}$ | |
| $Cr_{i4}$ | $Cr_{i4j1}$ | $Cr_{i4j2}$ | $Cr_{i4j3}$ | $Cr_{i4j4} = 1$ | |
| Sum | $Cr_{j1} = \sum_{l=0}^{n} ajl$ | $Cr_{j1} = \sum_{l=0}^{n} ajl$ | $Cr_{j1} = \sum_{l=0}^{n} ajl$ | $Cr_{j1} = \sum_{l=0}^{n} ajl$ | |
| $A_{Norm}$ | $\bar{a}_{j1}$ | $\bar{a}_{j2}$ | $\bar{a}_{j3}$ | $\bar{a}_{j4}$ | w = sum of row |
| $\bar{a}_{i1}$ | $\bar{a}_{i1j1} = \frac{\bar{a}i1j1}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i1j2} = \frac{\bar{a}i1j2}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i1j3} = \frac{\bar{a}i1j3}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i1j4} = \frac{\bar{a}i1j4}{\sum_{l=1}^{n}\bar{a}jl}$ | w1 |
| $\bar{a}_{i2}$ | $\bar{a}_{i2j1} = \frac{\bar{a}i2j1}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i2j2} = \frac{\bar{a}i2j2}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i2j3} = \frac{\bar{a}i2j3}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i2j4} = \frac{\bar{a}i2j4}{\sum_{l=1}^{n}\bar{a}jl}$ | w2 |
| $\bar{a}_{i3}$ | $\bar{a}_{i3j1} = \frac{\bar{a}i3j1}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i3j2} = \frac{\bar{a}i3j2}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i3j3} = \frac{\bar{a}i3j3}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i3j4} = \frac{\bar{a}i3j4}{\sum_{l=1}^{n}\bar{a}jl}$ | w3 |
| $\bar{a}_{i4}$ | $\bar{a}_{i4j1} = \frac{\bar{a}i4j1}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i4j2} = \frac{\bar{a}i4j2}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i4j3} = \frac{\bar{a}i4j3}{\sum_{l=1}^{n}\bar{a}jl}$ | $\bar{a}_{i4j4} = \frac{\bar{a}i4j4}{\sum_{l=1}^{n}\bar{a}jl}$ | w4 |

Comparison Matrix $A_{4x4}$

Where n = 4 (number of criteria compared), m = 6 (sum of the value of the comparison criteria), m = $n\frac{(n-1)}{2}$ and for each entry $a_{ij} \, x \, a_{ji}$ =1, entry $a_{jj}$ = 1, for all values of *"j"*, entry $a_{ii}$ = 1, for all values of *"i"*

$\Downarrow$

Cr *ij* is the result of the scoring/comparison between criteria *i* and *j* however the matrix is obtained by multiplying the value $A_{nxn}$ x $A_{nxn}$

$\Downarrow$

C *jl* is the sum of the values in column *j*

$\Downarrow$

$A_{normij}$ is $Cr_{ij}$ divided by the total of all $C_{ji}$

$\Downarrow$

The weight of the eigenvector *ij = w* is obtained by summing the rows of the matrix (Table 4.3) (The result is simplified to four decimal places)

$\Downarrow$

*Consistency test*

Picture 4.1 Flow Diagram showing the processing of the AHP Pairs Matrix

4. Testing the consistency of the scoring process.

After a number of pair comparisons were made several possible inconsistencies usually arise. For example it may be assumed that three criteria are being compared and a decision is made that the first is slightly more important than the second which is, in turn, slightly more important than the third. An inconsistency arises if an accidental decision is made that the third criteria is equally important as the first. AHP combines effective techniques to test for consistency in the evaluations made when constructing the pairwise comparison matrix *A*.

These techniques depend on calculating an appropriate consistency index *(CI)* which is obtained by first calculating scale *x* as an average of the elements in the *"j"* vector that represents comparisons between the *"j"* elements from vector $A{\cdot}w = \lambda_{max}.w$ to the corresponding elements of the vector *w*, so resulting in the following formula.

$$CI = \frac{\lambda \max - n}{n-1} \quad \text{.........................................(4)}$$

A consistent decision maker must always obtain CI = 0, however small values of inconsistency can be tolerated if:

$$CR = \frac{CI}{RI} < 0.1 \quad \text{......................................... (5)}$$

Where RI is the *Random Index*, that is the consistency index if the matrix entries were entirely random. Values of RI for small values of n (n≤10) are shown in table 4.4.

  

Table 4.4 Values of *Random Consistency Index (RI)* for small values of n

| *n* | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| *RI* | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.51 |

For a matrix $A_{3x3}$, the consistency values are calculated as in the examples below.

1. $A = \begin{bmatrix} 1 & 3 & 1/3 \\ 1/3 & 1 & 3 \\ 3 & 1/3 & 1 \end{bmatrix}$ $\frac{CI}{RI} = 1.15$ inconsistent

2. $A = \begin{bmatrix} 1 & 3 & 3 \\ 1/3 & 1 & 3 \\ 1/3 & 1/3 & 1 \end{bmatrix}$ $\frac{CI}{RI} = 0.118$ slightly inconsistent

3. $A = \begin{bmatrix} 1 & 3 & 5 \\ 1/3 & 1 & 3 \\ 1/5 & 1/3 & 1 \end{bmatrix}$ $\frac{CI}{RI} = 0.033$ consistent

For an AHP Pairwise Comparison Matrix, scoring is regarded as relatively consistent if the consistency ratio (CR) is less than 10% (Saaty, 1980).

**Data Processing**

Scoring of the importance of each determining factor to the reliability of the operation and maintenance of the irrigation system can be seen in Table 4.5 below :

  

Table 4.5 Determining factor for infrastructure operation and maintenance reliability

| No | Sub criteria (SCr) | Determining factor for irrigation infrastructure operation and maintenance reliability |
|---|---|---|
| 1 | SCr 1 | Number of personnel |
| 2 | SCr 2 | Quality of personnel involved in O&M |
| 3 | SCr 3 | Adequate budget from the associated organization |
| 4 | SCr 4 | Institutional power |
| 5 | SCr 5 | Good coordination between personnel |
| 6 | SCr 6 | Technical management efficiency |
| 7 | SCr 7 | Fiscal management efficiency |
| 8 | SCr 8 | Integration of management strategies for irrigation and drainage systems |
| 9 | SCr 9 | Management strategies appropriate to existing financial and socio - economic and environmental situation |
| 10 | SCr 10 | The existence of appropriate regulations related to the management of O & M |
| 11 | SCr 11 | Existence of supervision and sanctions |

Table 4.6 Scoring between factors

| No. | Comparison of factors | If of equal importance | If the first factor is more important than the second | |
|---|---|---|---|---|
| | | | Sub criteria | Score |
| 1 | SCr 1 – SCr 2 | 1 | | |
| 2 | SCr 1 – SCr 2 | | 3 | 3 |
| 3 | SCr 1 – SCr 2 | | 4 | 3 |
| 4 | SCr 1 – SCr 2 | | 5 | 3 |
| 5 | SCr 1 – SCr 2 | | 6 | 7 |
| 6 | SCr 1 – SCr 2 | 1 | | |
| 7 | SCr 1 – SCr 2 | 1 | | |
| 8 | SCr 1 – SCr 2 | | 9 | 3 |
| 9 | SCr 1 – SCr 2 | | 10 | 5 |
| 10 | SCr 1 – SCr 2 | | 11 | 7 |
| 11 | SCr 1 – SCr 2 | | 3 | 3 |
| 12 | SCr 1 – SCr 2 | | 4 | 3 |
| 13 | SCr 1 – SCr 2 | | 5 | 3 |
| 14 | SCr 1 – SCr 2 | | 6 | 7 |
| 15 | SCr 1 – SCr 2 | 1 | | |
| 16 | SCr 1 – SCr 2 | 1 | | |
| 17 | SCr 1 – SCr 2 | | 9 | 3 |
| 18 | SCr 1 – SCr 2 | | 10 | 5 |
| 19 | SCr 1 – SCr 2 | | 11 | 7 |
| 20 | SCr 1 – SCr 2 | 1 | | |
| 21 | SCr 1 – SCr 2 | | 5 | 3 |
| 22 | SCr 1 – SCr 2 | | 6 | 5 |
| 23 | SCr 1 – SCr 2 | | 3 | 3 |
| 24 | SCr 1 – SCr 2 | | 3 | 3 |
| 25 | SCr 1 – SCr 2 | | 3 | 3 |
| 26 | SCr 1 – SCr 2 | | 10 | 5 |
| 27 | SCr 1 – SCr 2 | | 11 | 5 |
| 28 | SCr 1 – SCr 2 | 1 | | |
| 29 | SCr 1 – SCr 2 | | 6 | 5 |
| 30 | SCr 1 – SCr 2 | | 4 | 3 |
| 31 | SCr 1 – SCr 2 | | 4 | 3 |
| 32 | SCr 1 – SCr 2 | | 4 | 3 |
| 33 | SCr 1 – SCr 2 | | 10 | 5 |
| 34 | SCr 1 – SCr 2 | | 11 | 5 |
| 35 | SCr 1 – SCr 2 | | 6 | 5 |
| 36 | SCr 1 – SCr 2 | | 5 | 5 |

  

| | | | | |
|---|---|---|---|---|
| 37 | SCr 1 – SCr 2 | | 5 | 3 |
| 38 | SCr 1 – SCr 2 | | 5 | 3 |
| 39 | SCr 1 – SCr 2 | | 10 | 5 |
| 40 | SCr 1 – SCr 2 | | 11 | 5 |
| 41 | SCr 1 – SCr 2 | | 6 | 5 |
| 42 | SCr 1 – SCr 2 | | 6 | 5 |
| 43 | SCr 1 – SCr 2 | | 6 | 5 |
| 44 | SCr 1 – SCr 2 | 1 | | |
| 45 | SCr 1 – SCr 2 | 1 | | |
| 46 | SCr 1 – SCr 2 | 1 | | |
| 47 | SCr 1 – SCr 2 | 1 | | |
| 48 | SCr 1 – SCr 2 | | 10 | 5 |
| 49 | SCr 1 – SCr 2 | | 11 | 5 |
| 50 | SCr 1 – SCr 2 | 1 | | |
| 51 | SCr 1 – SCr 2 | | 10 | 5 |
| 52 | SCr 1 – SCr 2 | | 11 | 5 |
| 53 | SCr 1 – SCr 2 | | 10 | 3 |
| 54 | SCr 1 – SCr 2 | | 11 | 5 |
| 55 | SCr 1 – SCr 2 | 1 | | |

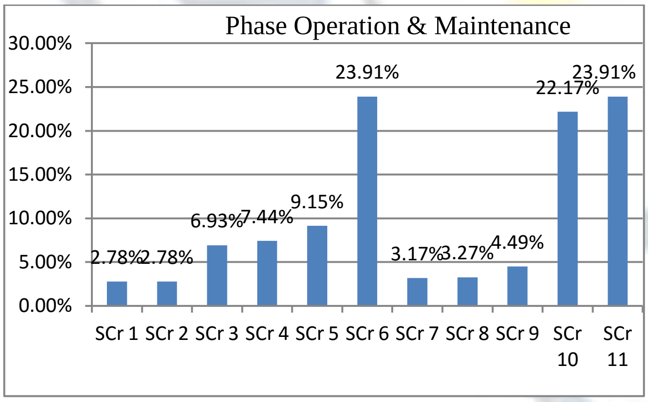


Figure 4.2 Weighting of determining factors influencing irrigation infrastructure operation and maintenance reliability

Table 4.7 Weighted rank of factors influencing irrigation infrastructure operation and maintenance reliability

| Rank | Determinan factors |
|---|---|
| 1 | Technical management efficiency |
| 2 | Existence of supervision and sanctions |
| 3 | The existence of appropriate regulations related to the management of O & M |
| 4 | Good coordination between personnel |
| 5 | Institutional strengthening |
| 6 | Adequate budget from the associated organization |
| 7 | Management strategies appropriate to existing financial and socio - economic and environmental situation |
| 8 | Integration of management strategies for irrigation and drainage systems |
| 9 | Fiscal management efficiency |
| 10 | Number of personnel |
| 11 | Quality of personnel involved in O&M |

From Figure 4.2 and Table 4.7 can be seen the determining factors playing a major role in irrigation system operation and maintenance reliability. Technical management receiving a ranking weight of 23.91%. The principle of management efficiency; that is water input = water output, water input = water used, and water output = 0 must be able to be optimized. However, in practice this management is not free from non-technical aspects such as economic factors and social ones, lack of available water flow, permeability of the soil, climatic factors affecting growth like the water requirements of crops and the variety of crops and the way they are grown along with the area of fields that is not only used for rice but also other crops either permanently in the form of inter- cropping or on a rotational basis.

  

Supervision and sanctions in the implementation of O & M also received the same ranking (23.91 %). An issue that is often encountered by management during field inspections is the difficulty in applying sanctions when the community violations occur, such as un-authorized water extraction, destruction of irrigation gates or embankments due to buffalo/cow grazing, garbage disposal into the irrigation channel. Along with the regulation of water resources, follow up the implementation of this regulation is still not strict. People who commit such violations can not be given the criminal sanctions that would deter them, therefore, managers have extra work to maintain the irrigation network.

The existence of appropriate regulations related to the management of O & M ranks third (22.17 %). Management of irrigation systems regulations exist already in Regulation No.20 / 2006 on irrigation, Ministry Public Work Regulation No. 13 / PRT / M / 2012 on Asset management of irrigation and No. 32 / PRT / M / 2007 on Operation and maintenance of irrigation systems. However, coordination procedures, the authority of parties involved in irrigation management and further facilities, including the institutional role and function Irrigation Commission (especially after the enactment of the Law on Regional Autonomy) need to be elaborated in more detail and integrated with these regulations.

Personnel involved in O&M are ranked last (2.78%), this is probably because the Irrigation system of Koto Kandis can be managed by two irrigation engineers, with the division of the area into two inspection units, that is the right Koto Kandis, and the left Koto Kandis irrigation system, two irrigation gate guards (Koto Kandis right and left), and one weir gate guard. Field inspection is carried out every day in different locations according to a timetable, upstream to downstream in rotation. The value of the Consistency *Ratio* (CR) for the comparison of these sub-criteria is 4.42%. As this value is < 10% the results of the comparison can be regarded as consistent.

# 4. CONCLUSION

The results of this study show that the significant determining factors influencing the reliability of the operation and maintenance of this irrigation system is the management efficiency of the O & M is technical management (23.91 %) , lack of supervision and sanctions in implementation (22.17 %) , and the existence of good regulation of the management (22.17 %). The value of the consistency ratio was 4.42 %. So it can be concluded that what is needed is clearer regulation and control along with further supervision from the responsible authorities (central, provincial and local government) to apply these regulations, especially with regard to implementation of the O & M of irrigation infrastructure and sanctions for persons who deliberately damage irrigation infrastructure.

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